Woodworking Machinery

Introduction

Incidence of Injuries

The woodworking trade in general industry rates as one of the most hazardous occupations. Rotating devices, cutting or shearing blades, in-running nip points, and meshing gears are examples of machinery that is hazardous in carpentry shops. Crushed hands, severed fingers, and blindness are examples of woodworking accidents.

Causes of Injuries

Unsafe Acts

o Jamming or kicking back of material and wood chips.

o Poor housekeeping.

o Improper material handling.

o Inhalation of wood dust.

Unsafe Conditions

o Flying objects (wood chips and broken saw blades, etc).

o Unsatisfactory maintenance of machinery.

o Inadequate guarding.

Prevention Overview

The majority of accidents involving woodworking machines could have been prevented by:

o Good work practices.

o Proper guarding.

o Sufficient operator training.

o Good housekeeping.

Scope and Purpose

This technical reference provides general guidance for working with woodworking machinery. Specific machines require specific practices, for example operator instructions from the manufacturer.

Basic Terms

Chuck. A revolving clamp-like device used for gripping and driving stock or tools.

Dog. A device for gripping or holding material or machine components in place.

Feather Board. An angular board with multiple parallel saw cuts that is used as a side and top hold-down to prevent kickbacks and keep hands away from moving blades and cutters.

Guard. A barrier that prevents entry of the operator's hands or fingers into the point of operation.

Kickback. The tendency of blades and cutters to force material being milled or cut to suddenly move up and back towards the operator.

Point of Operation. The area(s) of a machine where cutting, shearing, forming, assembling, etc., takes place.

Push Stick (Block). A strip of wood or block with a notch cut into one end that is used to push short or narrow lengths of material through saws

Standards and Codes

Group Standard Subject

OSHA 29 CFR 1910.211 Machinery and machine guarding

OSHA 29 CFR 1910.212 General requirements for all machines

OSHA 29 CFR 1910.213 Woodworking machinery requirements

OSHA 29 CFR 1910.219 Mechanical power transmission apparatus

ANSI 01.1-1975 Safety requirements for woodworking machinery

ANSI/ASME B11.19 Performance criteria for the design, construction, care, and operation of safeguarding when referenced by other B11 machine-tool safeguards

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OSHA = Occupational Safety and Health Administration.

ANSI = American National Standards Institute.

Protective Devices

Personal Protective Equipment

Protective eye and face equipment is required where there is reasonable probability of injury while performing woodworking tasks. It is the responsibility of the employer to make suitable protection available. More information can be obtained about eye and face protection in ANSI Std Z87.1-1968. Persons whose vision requires the use of corrective lenses and who are also required to wear eye protection must have one of the following:

- Spectacles whose protective lenses provide optical correction.
- Goggles that can be worn over corrective spectacles without disturbing the adjustment of the spectacles.
- Goggles that incorporate corrective lenses mounted behind the protective lenses.

Respirators must be provided by the employer when such equipment is necessary to protect the health of employees. An industrial hygienist, through the respiratory protection program, will determine shop and employee requirements. Hearing protection must also be provided when exposure to noise exceeds the federal standard or any ANSI standard pertaining to woodworking requirements. The industrial hygienist also determines those requirements.

Electrical Safeguards

All machinery must be installed according to the National Electrical Code (NEC). If machines have

exposed noncurrent-carrying metal components, they have the potential to become energized and should be grounded. Control switches should be available to workers at their operating positions so they do not need to reach over moving parts of machinery. Also, machine controls must not be wedged for continuous operation.

Machines that are not adequately safeguarded to protect the worker during an under voltage situation or a power failure must have an under voltage protective device installed. This device prevents the machine from starting up after a power interruption, which may, in some cases, expose the worker to the hazards of moving parts.

Before performing maintenance or major adjustments to moving parts that require panels and guards be removed, all machine energy sources or energy isolating devices must be locked and/or tagged out.

Machine Guarding

Circular, Crosscut, and Rip Saws

Guarding beneath the table level should be provided to enclose the saw blade from unintentional contact and prevent contact with moving parts of the drive mechanism. Saws must be equipped with a hood that covers the blade and automatically adjusts itself to the thickness of the material upon which it rides. The hood covers the part of the saw blade exposed above the material and is adaptable to cover tilted blades. When ripping, table saws must be provided with a spreader to prevent the wood's internal stresses from clamping down on the saw blade and an anti kickback device to prevent the stock from possible kickback.

Radial Saws

Radial saws must be equipped with a hood that encloses the saw blade and the arbor ends. The lower section of the hood must be hinged so it rises and falls and adjusts itself automatically to the thickness of the material as the saw passes through it. An antikickback device or hold-down wheels must also be installed on saws used for ripping. The device must be adaptable to any thickness of stock.

Band Saws

Both upper and lower wheels must be completely enclosed on both sides. The enclosures should be capable of being removed easily to permit saw blade maintenance. The working part of a saw blade, between the guide rolls and the upper wheel enclosure, must be guarded to prevent accidental contact with the saw blade. The guard must be self-adjusting and attached to the gauge so that, in any position of the gauge, the guard completely covers the portion of the saw blade between the guide rolls and the upper wheel enclosure.

Jointers

Each hand-fed planer and jointer with a horizontal or vertical head should be equipped with a cylindrical cutting head, the knife projection of which must not exceed 0.125 inch (0.31 centimeters) beyond the cylindrical body of the head. Also, jointers with front-table-mounted fences must be equipped with an adjustable device to prevent thin stock from slipping laterally under the portion of the fence at the rear of the table. An automatic guard must be provided that covers the section of the cutter head near the operator (on the working side of the fence) and contacts the wood to prevent any opening from remaining between the guard and wood during the operation. The guard should also cover the section of the cutter head on the nonworking side of the fence, especially when the fence is moved toward the automatic guard. The guard over the section of the cutting head on the rear side of the fence should consist of a sliding metal shield that automatically adjusts to the exposed length of the cutter head.

Power Feed Planers

Guards must be provided for feed rolls, cutting heads, and hold-down rolls at the discharge end. Feed rolls should be guarded by a metal strip in front of the rolls under which the material may pass. This prevents an operator's fingers from being drawn into the rolls while feeding the machine. Where the top roll is corrugated, the strip should extend over the top of the roll. Cutting heads and discharge rolls must be guarded by a solid metal enclosure of substantial construction. The hood of an exhaust system may form part or all of the enclosure. When other than corrugated top feed rolls are used, an anti-kickback device should be installed.

Shapers

Shapers must be equipped with a braking device that brings the cutting head to a stop within 10 seconds after power is shut off. Cutting heads must be enclosed by a guard. The guard must not be less than the greatest diameter of the cutter. Whenever possible, hold downs and jigs should be used to limit exposure of hands to cutters. It is good practice when a blade is removed from a spindle for sharpening, or for some other purpose, that all other blades be removed at the same time.

Lathes

Rotating, cutter-head type lathes must be provided with a hinged metal shield or hood that completely covers the knives and material when the machine is in operation. Exhaust system hoods may be included as part of the guard if they comply with standard guard designs. Automatic lathes should be equipped with a brake that brings the rotating material to a quick, but not instantaneous, stop after the power is shut off.

Sanding Machines

Feed rolls of self-feed sanding machines should be protected with a semi-cylindrical guard to prevent hands from coming in contact with the in-running rolls at any point. The guard and its mounting should be designed to remain in adjustment for any thickness of stock. Drum/disk sanding machines should have an exhaust hood, or other guard, so arranged as to enclose the revolving drum/disk, except for the working portion of the drum/disk above the table. Belt sanding machines should be provided with guards at each nip point. These guards must effectively prevent hands or fingers from coming in contact with the nip points. The unused run of the sanding belt must be guarded against accidental contact.

Boring and Mortising Machines

The top of the driving mechanism must be enclosed.

Tenoning Machines

Feed chains and sprockets of double end tenoning machines must be completely enclosed, except for that portion of chain used for conveying the stock. Sprockets and chains must be guarded at the sides by plates projecting beyond the periphery of sprockets and the ends of lugs at the rear ends of frames over which feed conveyors run. Each tenoning machine that has cutting heads and saws must be covered by metal guards when used. These guards should cover at least the unused part of the periphery of the cutting head. Where an exhaust system is used, the guard may form part or all of the exhaust hood.

Work Practices

General

Supervisors must ensure that only authorized employees operate and maintain shop equipment. Personnel who are operating, helping, or observing machine operations must comply with the personal protective equipment requirements for the area and particular machine. Employees must not wear loose fitting clothing, rings, bracelets, or other apparel that can become entangled in moving machinery, power transmission apparatus, or moving parts. Also, hair nets or caps should be worn to keep long hair under control and safely away from moving machinery and parts.

Machines must not be operated unless all guards are in place and in working order. For instance, there must be a self-adjusting guard on the working side of the fence on a jointer. However, guards may have to be removed for certain cuts. In those instances, additional precautions must be taken that afford the same protection. For example, narrow cuts on table saws should be performed with feather boards and push sticks. Also, machines must be used only for work within the rated capacity specified by the machine manufacturer. If an employee needs to clear jammed work or clean around the machine, it should be completely stopped and the main power turned off. In some cases, the equipment will also have to be locked or tagged out of service.

Cleanliness around woodworking machinery must be maintained at all times. During cleaning, chips or other particles can be removed by brushes or compressed air. If compressed air is used, the nozzle pressure at the discharge end of the air line should not exceed 30 psi. Compressed air may not be used to blow chips or other debris from a worker's body or clothing.

A machine should never be left unattended with the control switch in the "on" position. Also, no blades, cutter heads, or collars should be placed or mounted on a machine arbor unless it has been accurately sized and shaped to fit the arbor. If blades are dull, badly set, improperly filed, or improperly tensioned, they should be immediately removed from service. Sharpening or tensioning saw blades or cutters must be done only by employees demonstrating the proper skill for this kind of work.

Inspections

Inspections should be performed periodically by a supervisor or other qualified person familiar with the machinery. As a minimum, inspections must determine that:

o The operator and machine are equipped with the safety accessories

suitable for the hazards of the job.

o The safety equipment is in working condition and in place.

o The machine operator is properly trained.

Documentation reflecting inspection results must, as a minimum, contain the machine number, inspection date, discrepancies noted, and corrective actions.

Machine Operators

Operators and others who are exposed to moving parts can get clothing, hair, or body parts caught in the machinery. The chance of these mishaps occurring is greater as fatigue increases or as attention decreases. Pressure to get the job done may result in either overlooking sound work practices or attempting to bypass guards. This is particularly true when the operation requires the removal of guards to make adjustments.

Acquisition

All newly acquired machines should meet the design and construction requirements identified in the OSHA standards. Supervisors needing access to OSHA standards or help in making a guarding determination for a machine not specifically covered by OSHA, should contact their safety staff.

Installation

Machines designed for fixed locations or that might tip over should be securely fastened to the floor or other suitable foundation to eliminate all movement or "walking." Small units should be secured to benches, tables, or stands of adequate strength and design. Weight limitation of floors or foundation should be considered prior to machinery installation.

Machines should be arranged in a manner that permits an even flow of materials and eliminates backtracking and crisscrossing. Adequate space should be provided to allow handling material with the least possible interference from or to workmen or other machines. Machines should be located so it will not be necessary for an operator to stand in or near an aisle. Additionally, the layout of machines should allow for easy maintenance and repair. (For detailed information on shop layout, passageways, and machine clear zones, refer to OSHA standard 1910.21, Walking-Working Surfaces.)

It is recommended that the height of the table or point of operation above the floor for various machines be as shown in Table 4.1.

Industrial hygienists will determine the requirements for exhaust systems. Normally, machines that develop fine dust and fumes that are hazardous to workers should be equipped with effective hoods and connected to an exhaust system.

Floors and Aisles

Floors and aisles should be kept in good repair and free from discrepancies such as protruding nails, splinters, holes, unevenness, and other tripping hazards. Floors in working areas should also be provided with an effective means to prevent workers from slipping. Aisles and walkways should be straight as possible, with corners rounded or diagonal. Lines marking the floor around work spaces and aisles may be painted on the floor, or some similar method employed to highlight them.

4.1 Machine Height (in.)

Circular saws (hand fed) 36 "

Circular saws (power fed) 32 "

Band saws 46 "

Shapers 36 "

Jointers 33 "

Lathes 41 "

Sanders 36 "

Radial arm saws 39 "

Training

Employees must be trained on all machinery or equipment they are required to use. Usually, shop personnel are trained by their supervisor or a designated trainer. Only trained personnel or those undergoing supervised on-the-job training should be allowed to operate shop machinery or equipment. All operators should be trained in the proper operation, safety procedures, hazard recognition, and emergency shutdown procedures for each machine or piece of equipment they use.

The operator training programs should be tailored to an employee's work area. Employees learn more and draw a greater benefit from training that duplicates their daily work rather than a "canned program." As a minimum, the training program should include:

o The nature of hazards for each piece of equipment.

o Safety procedures for special set-ups for each tool.

o How to perform work in a safe manner.

Additionally, the training should be devised so employees can demonstrate their knowledge and skills required to perform their tasks. The supervisor must determine that the employee knows and understands the features of the equipment, all applicable safety rules, and is skilled in operating the equipment.

Hazards

Many injuries that occur in woodworking occupations result from employees failing to follow prescribed safe operational practices. These failures arise from worker attitudes, inadequate training, and supervisory failure to enforce safe job procedures. The use of machine guards, environmental controls, good training, and maintenance programs, coupled with supervisory enforcement of protective equipment use and safe job practices can eliminate most mishap-producing factors.

Among the most frequently occurring woodworking accidents are two involving saws:

(1) blade cuts or abrasions, (2) kickbacks.

Circular saw operators are often injured when their hands slip from the stock while pushing it into the saw or when they hold their hands too close to the blade while cutting. Kickbacks occur during ripping when a part or all of the work piece is violently thrown back at the operator.

Operators should keep their face and body to one side of the saw blade, out of line with a possible kickback.

Overhead swing saws and straight-line pull cutoff saws cause hand injuries because of several operational characteristics. Hands are sometimes cut while the saw blade is coasting or idling and the

operator attempts to remove a section of board, or while measuring a board and the saw is still running. Also, the operator may pull the saw against his or her hand or may suffer body cuts from a saw that swings beyond its safe limits. Overhead swing saws, like straight-line pull cutoff saws, require many adjustments to permit their full use. Sometimes these adjustments can create additional hazards for the user.

The principal sources of injury connected with radial saw operations are those common to other power-driven saw operations. They include cutting injuries to the arms and hands caused by the saw blade, by flying wood chips, and by handling materials. When crosscutting, radial saws cut downward and pull the wood away from the operator and against the fence.

Although injuries from band saws are less frequent and less severe than those from circular saws, they are not uncommon. The usual cause of band saw injuries is the user's hands coming into contact with the saw blade. When hand feeding, the operator's hands must come close to the blade. Therefore, it is particularly important that the saw table be well lighted and free from glare. Band saw point of operations cannot be completely covered. However, an adjustable guard, U-shaped and designed to prevent operator contact with the front and sides of the saw blade above the upper blade guides, should be set as close as possible to the work piece.

Jig saws are not normally considered hazardous, but occasionally cause injuries to the fingers and hands. Safe operating procedures require the blade be properly attached and secure, the threshold rest (slotted foot) to be on the stock, the guard to be in an effective position, and the operator to keep his or her hands a safe distance away from the blade.

The principal danger in the use of the wood shaper is that hands and fingers might strike the revolving knives. Therefore, a ring guard is suggested. Severe accidents can also result when broken knifes are thrown by the machine. When a shaper knife breaks or is thrown from the collar, the other knife is usually thrown too, so that four or five pieces of heavy, sharp steel are thrown about the shop with sufficient speed to kill a person. The danger from broken or thrown knifes can be eliminated by using solid cutters that fit over the shaper spindle. Also, there are various types of safety collars that can be used to prevent shaper knifes from flying. However, collars should not be considered substitutes for

perfectly balanced and fitted knifes of adequate length.

Hand-feed jointers or surface planers are, second to circular saws, considered the most dangerous woodworking machines. Most of the injuries are caused by hands and fingers contacting the knifes. Many of these accidents occur when narrow lengths of stock are being jointed. The National Safety Council recommends that hold-down push blocks be used whenever the operator joints wood that is narrower than 3 inches . Also, it is mandatory that the unused end of the cutting head be enclosed at all times. A sheet metal telescoping guard is acceptable for this purpose.

Drum, disk, or belt sanding machines should be enclosed by an exhausting dust hood that encloses all portions of the machine except the portion designed for the work feed. Personnel who operate sanders should wear goggles and dust respirators during sanding operations and cleanup. On a belt sanding machine, a guard should be placed at each in-running nip point on both power transmission and feed roll parts. The unused run of the abrasive belt on the operator's side of the machine should be guarded to prevent contact.

Safety Rules for

Various Woodworking Tools

Every operator should be trained in the safety rules covered here. As a summary, specific safety conditions that demand close attention are listed below. Be sure that the operator checks the manufacturer's manual, understands the requirements, and follows the recommended procedures.

Table Saw Jointer/Planer

o Feed with body to side of stock. o Check depth of cut.

o Ensure correct blade height. o Use minimum length of stock.

o Use splitter and antikickback o Ensure cutters are sharp.

fingers for ripping. o Ensure hands do not pass over cutters.

o Use with stock firm against fence. o Use push stick for small stock.

o Remove rip fence for crosscuts. o Check all guards.

o Use blade guards.

Circular Saw Wood Shaper

- Use blade guards o Clamp work piece
- Do not let the blade bind o Use correct guard
- Use correct type blade o Feed into knifes-don't back off
- Make sure blade is tight on arbor o No feeding between fence and cutters
- Use firm support for work o Ensure fence opening is only enough to clear cutters
- Ensure no obstructions o Use stock as guard by shaping the
- Begin cut with motor at side of stock

manufacturer's recommended speed o Ensure spindle nut is tight

Radial Arm Saw Sander

o Ensure the ripsawing direction o Keep hands from abrasive surface.

of the cut, feed, and antikick o Check belt or disk condition.

fingers. o Sand on downward side of disk.

o Use blade guards.

o Pull for cross cuts. **Lathe**

o Ensure end plates are on track.

o Clamp handles tight. o Use stock without defects and make

o Ensure materials are tight to the sure glued joints are dry.

fence. o Hold tool rest close to stock.

o Return cutter to rear of track. o Hold tools firmly in both hands.

o Remove tool res when sanding or polishing.

Band Saw

o Feed with body to side of stock.

o Set guard height for 0.125-inch clearance.

o Use correct tension and proper type of blade.

o Release cuts before long curves.

o Use flat stock.

o Stop machine to remove scrap or pull out incomplete cut.

Woodworking Machinery Safety Checklist

This safety checklist will help employees and supervisors follow minimal safety practices. This list is not meant to be comprehensive or to form part of any official self-assessment practice. Where appropriate, local safety offices and supervisors are encouraged to add to these checklists.

Circular, Crosscut, Rip Saws

Is the table saw equipped with a hood that covers the blade and automatically adjusts itself to the thickness of the material upon which it rides?

29 CFR 1910.213(c)(1)

Does the hood cover the part of the saw blade exposed above the material?

29 CFR 1910.213(c)(3)(e)

Is the hood adaptable to cover tilted blades?

29 CFR 1910.213(a)(6)

Is a spreader provided at the table saw to prevent the wood's internal stresses from clamping down on the saw blade?

29 CFR 1910.213(c)(2)

Are table throat openings kept as small as possible to prevent material from dropping below the level of the table?

29 CFR 1910.212(a)(1)

Are antikickback dogs/fingers or safety hold-down wheels installed when material is being ripped?

29 CFR 1910.213 (c)(3)

Is the blade or cutting head inspected for proper cutting condition (i.e.., teeth sharp and properly set, no cracks, free of foreign residue) before a job is started?

29 CFR 1910.213 (s)(1)(i)

Radial Arm Saw

Are radial saws equipped with a hood which encloses a saw blade and the arbor ends? ***29 CFR 1910.213 (h)(1)***

Is the lower section of the hood adjustable so it rises and falls automatically to the thickness of the material as the saw passes through it?

29 CFR 1910.213 (h)(1)

Is an antikickback device or are hold-down wheels installed on saws used for ripping? ***29 CFR 1910.213 (h)(2)***

Does the device adapt to any thickness of stock to be cut?

29 CFR 1910.213 (h)(2)

Are manually operated radial saws installed so the front end of the table is slightly higher than the rear so the cutting head does not move forward when the motor is turned on?

29 CFR 1910.213 (h)(4)

Does the saw have a positive limit-stop to prevent the saw from traveling beyond the front edge of the table?

29 CFR 1910.213 (h)(3)

Is the direction of the saw rotation conspicuously marked on the hood?

29 CFR 1910.213 (h)(5)

Is a permanent decal or sign not less than 1 inch by 0.75 inch , reading "CAUTION; NEVER RIP FROM

THIS END" (or the nearest commercially available equivalent)

affixed to the rear of the guard at approximately the level of the arbor?

1. ***29 CFR 1910.213 (h)(5)***

Band Saws

Are both upper and lower wheels completely enclosed on both sides of the band saw?

29 CFR 1910.213 (i)(1)

Is the guard self-adjusting and attached to the gauge so that (in any position of the gauge) the guard will completely cover the portion of the saw blade between the guide rolls and the upper wheel enclosure?

29 CFR 1910.213 (i)(1)

Is the saw equipped with an automatic tension control?

29 CFR 1910.213(i)(2)

Does the feed roll on a self-fed band saw have a guard to prevent the operator's hands from coming into contact with the in-running rolls at any point?

29 CFR 1910.213(i)(3)

Jointers

Is each hand-fed planer and jointer (with a horizontal or vertical head) equipped with a cylindrical cutting head?

29 CFR 1910.213 (j)(1)

Does the knife on these machines project no more than 0.125 inches beyond the

cylindrical body of the head?

29 CFR 1910.213 (j)(1)

Is the opening in the table kept as small as possible?

29 CFR 1910.213 (j)(2)

Is the clearance between the edge of the rear table and the cutting head circle or knife no more than 0.125 inches?

29 CFR 1910.213 (j)(2)

Is the table throat opening no more than 2.5 inches when tables are reset or aligned

with each other for a zero cut?

29 CFR 1910.213 (j)(2)

Power Feed Planers

Are feed rolls guarded by a metal strip in front of the rolls under which material may pass, but will prevent an operator's fingers from being drawn into the machine?

29 CFR 1910.213 (n)(3)

Are cutting heads and discharge rolls guarded by a solid metal enclosure of substantial construction?

29 CFR 1910.213 (n)(1)

When other than corrugated top feeders are used, is an antikickback device installed?

29 CFR 1910.213 (n)(4)

Lathes

Is a hinged metal shield or hood (that completely covers the knives and material when the machine is in operation) provided on rotating, cutter-type lathes?

29 CFR 1910.213 (o)(2)

Sanding Machines

Is a guard installed on the feed rolls of self-feed sanding machines?

29 CFR 1910.213 (p)(1)

Are guards installed at each nip point on a belt sanding machine?

29 CFR 1910.213 (p)(4)

Boring and Mortising Machines

Is the unused run of the sanding belt guarded?

29 CFR 1910.213 (p)(4)